Making Space Flight Safer

Center for Nondestructive Evaluation launches a program to improve reliability of spacecraft and future aerospace vehicles.

IPRT's Center for Nondestructive Evaluation has begun a ground-breaking program to improve the reliability of future aerospace systems and to assist NASA with solving some more immediate safety and mission-assurance problems of space vehicles.

The effort, made possible with a grant from NASA, draws on ISU's core strengths in sensors and materials processing. The project will contribute to the development of a new class of sensors integrated within aerospace structures to continuously monitor the structure's condition and take corrective actions.

The CNDE program will focus on 15 technical areas and includes projects that will allow ISU's core strengths to be extended into new areas. In addition to scientists currently working with CNDE, the program will draw on the expertise of other ISU scientists in the academic departments of materials science and engineering, physics, and electrical and computer engineering, as well as in other research centers.

"Ageless" Vehicles

This new approach to sensors is central to NASA's goal of "ageless" aerospace vehicles as described in the NASA aeronautics blueprint, "Toward a Bold New Era of Aviation."

photo: NASA/JSC

IPRT's Center for Nondestructive Evaluation will help improve the reliability of future aircraft and spacecraft in a new research effort with NASA.

"The idea is to develop vehicles that are, in some sense, like an organism — they can sense damage or degradation in their conditions and can take action on what they have sensed. Further down the road, the potential exists for a structure to actually heal itself," said R. Bruce Thompson, CNDE director and distinguished professor of engineering at ISU.

Some of the futuristic concepts that ISU scientists will work on include integrated fiber optic sensors; aircraft skins that "morph," or change shape, to adapt to their environment; nanotube-based sensors; materials that can be designed to perform special functions by mimicking biological systems; and novel ceramic-based sensors.

Thompson described the concept of self-healing — vehicles repairing themselves — as a new area of research. The basic idea is, in order for something to self-heal, the material to repair the damage must be transported to where it is needed. "One of our scientists is looking at diatoms, a type of microscopic organism with tiny tubes in it, that have a tremendous range of shapes. We'll be looking at whether you can grow the organism but then replace the organic material with an inorganic material to have the structure and shape you want," he said.

Adapting NDE to Spacecraft

With human safety at the top of NASA's space priorities, the ability to locate leaks and conduct thorough inspections on vehicles and equipment in outer space is crucial. Scientists in the CNDE have a wide range of expertise in nondestructive evaluation techniques that can be used or adapted for use in settings unique to NASA.

The CNDE program includes projects aimed at leak detection and extra vehicular assessment of spacecraft, advanced techniques to inspect composite materials, the use of simulators to guide the rapid development of optimized inspection techniques, and the development and evaluation of novel approaches to detect the very early stages of damage.

"As more aerospace vehicles are built with composite and multilayered engineering materials, questions about their aging becomes more critical. We will be working with NASA to examine a set of specimens with a well-controlled history to try to better understand the mechanisms of degradation of composites used in structures," Thompson explained.